

User Interface Design Document for the Land Information System

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Increasing Interoperability and Performance of Grand Challenge Applications in the Earth, Space, Life, and Microgravity Sciences

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Acronyms and Terms

AGRMET: Agriculture Meteorology Model

AVHRR: Advanced Very High Resolution Radiometer

CGI: Common Gateway Interface

CLM: Community Land Model

COLA: Center for Ocean-Land-Atmosphere Studies

DAO: Data Assimilation Office

DODS: Distributed Ocean Data System

ECMWF: European Center for Medium-Range Weather Forecasts

EOS: Earth Observing System

FTP: File Transfer Protocol

HDF: Hierarchical Data Format

GOES: Geostationary Operational Environmental Satellite

GrADS: Grid Analysis and Display System

GRIB: Gridded Binary

LDAS: Land Data Assimilation System

LRD: LIS Requirements Document

LIS: Land Information System

NET-CDF: Network Common Data Form

NOAH: National Centers for Environmental Prediction, Oregon State University, United States Air Force, and Office of Hydrology Land Surface Model

NVDOS: National Virtual Oceanographic Data System

NRL: Naval Research Laboratory

TBD: To Be Determined

TRMM: Tropical Rainfall Measuring Mission

USGS: United States Geological Survey

VIC: Variable Infiltration Capacity

1 Introduction

This User Interface Design Document establishes the user interface design for the Land Information System (LIS). LIS is a project to build a high-resolution, high-performance land surface modeling and data assimilation system to support a wide range of land surface research activities and applications.

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1.1 Purpose and goals

This document serves as the blueprint for the user interface of the Land Information System (LIS).

The design goals of LIS user interface are to allow Internet users access to LIS data by using data mining, numerical modeling, and visualization tools provided by the Grid Analysis and Display System and the Distributed Oceanographic Data System, or the GrADS-DODS Server (LRD, Sec 2.1), the Live Access Server, or downloading the raw data using FTP.

1.2 Scope

This document covers the design of all the LIS user interface components for the three-year duration of the LIS project. The document focuses primarily on the implementation of the LIS user interface running on a Linux cluster, with users accessing LIS data through Netscape/IE 4.x or higher. This document does not cover design for other hardware/software platforms.

2 User interface components

The user interface subsystem takes a typical multi-tier client-server system architecture. On the client side, a user has three types of client programs to use as the front-end: a web browser, an ftp client program (which can be integrated in a web browser), or a DODS client program. On the server side, a general-purpose web server will be used to serve clients with a web browser, and a GrADS-DODS server will be deployed to serve DODS clients, and a FTP server to serve ftp clients. Besides these components, CGI scripts and CGI-GrADS gateway scripts will be used as the middleware to perform dynamic processing based on users' interactive requests sent through web browsers. Figure 1 shows the user interface architecture design.

The user interface of LIS is an important component of LIS that will allow the interactive, flexible use of the LIS hardware and software to users. The LIS user interface is intended to be web-based, and designed to allow for cascading complexity

depending on the level of user's need to control the system. Users accessing the LIS are categorized into three levels, associated with different levels of data access and security requirements (LRD, Sec. 6.1).

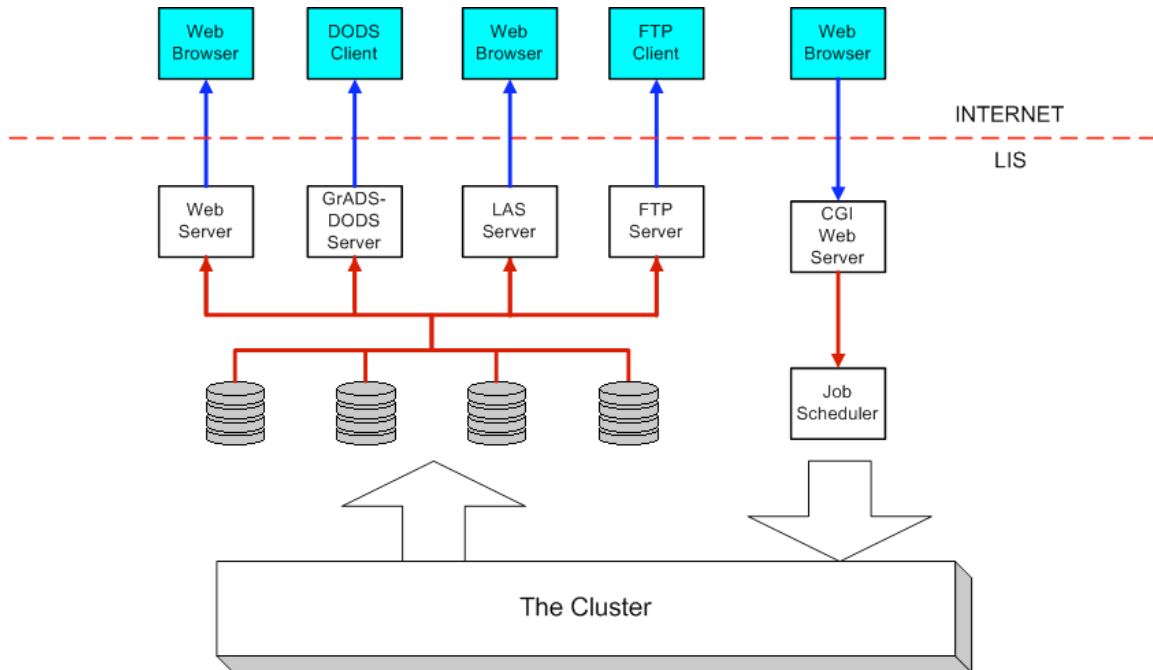


Figure 1: LIS user interface architecture

This diagram illustrates the three levels of data access. The first arrow from the left represents Level 1 users, who will access static data using a Web browser. The next three arrows represent Level 2 users, who will be accessing LIS data using the following three methods: 1) by using a Web browser to dynamically generate images and manipulate data using the Live Access Server; 2) by using a DODS client to manipulate a subset of data; and 3) by downloading an entire set of raw data via FTP. The last arrow, representing Level 3 users, will perform model runs using a web-based interface to submit a job.

All user levels will be able to access the LIS user interface via a web browser, with an entry page as shown in Figure 2.



Figure 2: Screenshot of the LIS entry page

3 User levels and security design

As discussed above, outside users accessing the LIS are categorized into three levels, associated with different levels of data access and security requirements. This section describes the functionality and interface design associated with each user level.

3.1 Level 1 Users and the LIS Browser Interface

Level 1 users are the general public, who will access the LIS data through a standard web browser (LRD, Sec 6.2.1). Information provided to this class will only include static images, animations and text. An image gallery will be created with images and short animations available for download (LRD, 6.2.1.1). This static content is served via the web server. This group of users does not have direct access to the data or LIS scientific computing power system, and their usage of system resources is very limited. Therefore, for this class of users we do not enforce any additional authentication or authorization procedures. It is also our intention to facilitate easy access to images for education and outreach purposes.

Data provided to Level 1 users will be as follows:

Overview: A short overview of the LIS project and its origins.

Contacts: Names and contact information for LIS team members and collaborators.

Links: Links to research related to LIS

Documentation/Source Code: All LIS Documentation and Source Code will be available to the public via the World Wide Web

Gallery: A gallery of retrospective images and animations.

3.2 Level 2 Users, GrADS/DODS and LAS

Level 2 users will have more direct access to LIS data. They will accomplish this by either dynamically generating an image via a web browser; by using a DODS client; or directly through ftp fetches. The GrADS-DODS server provides the users with the ability and flexibility to get only a sub-set of the data they need. If the entire data set is desired, users will be able to directly download the raw data from the LIS ftp server.

A Level 1 user must register with us before they can become a Level 2 user. Users will be required to fill out web forms, and their information will be stored on our server. Each time a Level 2 user logs in via the LIS web site, their username and password will be authenticated using CGI and Java scripts. Registration is being used to allow an extra layer of security between the World Wide Web user and the LIS hardware/software. The GrADS-DODS server will also impose a limit on system resource usages, as shown in Table 1 (LRD Sec. 9.5).

Table 1: Configurable GrADS-DODS parameters for access to level 2 users of LIS

Parameter	Description
Subset limit	Sets the maximum size in megabytes of a subset
Generate limit	Sets the maximum size in kilobytes of a generated dataset
Upload limit	Sets the maximum size in kilobytes of an uploaded dataset
Time limit	Sets the maximum time in milliseconds that a dataset generation task is allowed
Hit limit	Sets the maximum number of hits per hour permitted from a specific IP
Abuse limit	Sets that length of time in hours an IP address will be blocked out after exceeding the hit limit
Deny datasets	A comma delimited list of datasets that should not be accessible
Allow datasets	A comma delimited list of datasets that

should be accessible

Level 2 users will be able to visualize LIS data by using the Live Access Server (LAS), developed by the National Oceanic and Atmosphere Administration. LAS is a highly configurable Web server designed to provide flexible access to geo-referenced scientific data. LAS can be configured to display data accessed via DODS. The Center for Ocean-Land-Atmospheric Data (COLA) will assist in configuring LAS to serve as a front-end interface for LIS.

LAS enables the Web user to:

- Visualize data with on-the-fly graphics
- Request custom subsets of variables in a choice of file formats
- Access background reference material about the data (metadata)
- Compare (difference) variables from distributed locations

LAS enables LIS as the data provider to:

- Unify access to multiple types of data in a single interface
- Create thematic data servers from distributed data sources
- Offer derived products on the fly
- Remedy metadata inadequacies (poorly self-describing data)
- Offer unique products (e.g. visualization styles specialized for the data)

Figure 3: A LAS web interface

The Live Access Server provides a user-friendly interface to allow Level 2 users to visualize or analyze data, as shown in Figure 3. Users can subset the spatial domain using the LAS point and click interface. Users can select different views, such as lat/lon/lon/depth, lat/depth, depth/time, and others. Users are provided with a variety of output formats, including NetCDF, text, ArcView gridded, GIF images, and others.

LIS data will also be made available to Level 2 users who need direct access to the data in near real-time (LRD, Sec 6.2.2.1) using desktop software. Users who are utilizing a DODS client (GrADS, Matlab, IDL, etc.) will be able to directly manipulate subsets of LIS data through the DODS protocol. An FTP server will also be in place to allow users to download raw data sets to their desktops as needed. All FTP usage will be monitored and logged for security purposes (LRD, Sec. 9.4)

3.3 Level 3 Users and the LIS Configuration Interface

Level 3 users have the highest access level in addition to all the Level 2 and Level 1 access privileges; they will be able to access the parallel computing power of LIS system. This group will be the LIS developers and collaborators, and a select group of users. The number of these users will be limited, and the authorization and authentication process will be enforced using password and source IP addresses (LRD, Sec 6.2.3). All Level 3 users will have an account on the LIS cluster.

For flexibility purposes, Level 3 users will be able to use either a command-line interface for customized model runs, or a web-based interface for simple model runs. Using the command line, a Level 3 user will first be able to customize their own copy of the LIS model configuration file, then submit a job to the LIS cluster that will run the model based on the user's specific parameters. The output will then be stored in the user's home directory on the cluster.

The web-based interface will generate a configuration file that will run one of the land surface models, and specify the model forcing and the model parameters needed (LRD, Sec 6.3). The web-based interface will store a copy of the parameters input via the screen for later review. The web-based interface will also collect the information needed to set up the output as either a data file, a file ready for the image generator or both. A number of CGI scripts will be interfacing the web input and the LIS system's job scheduler.

The LIS model configuration web interface will collect the following information:

3.3.1 *Model Physics*

Land Surface models available will be NOAH, CLM, and VIC.

An error message will be displayed when VIC is selected until 7/03.

Leaf Area Index (LAI) Schemes available will be LAI original and AVHRR derived. Other possibilities are Evaporation Scheme, Infiltration Scheme, Snowmelt Scheme, Sub Grid Tiling, Runoff Routing, Dynamic Groundwater, and Dynamic Vegetation.

3.3.2 *Temporal Domain*

Start and stop time of the run in Year, Month, Day and Hour.

Years available will be from 1952 to 2048

Month available will be January thru December

Day of the month will be 01-31 as appropriate and leap year day included

Hour available will be from 00:00 midnight to 24:00 in military time, GMT

Time step of the run in either 900 seconds or 1800 seconds

3.3.3 *Spatial Domain*

Domains available will be Global, Continental, and User Supplied

User Supplied domain will be minimum and maximum Latitude and Longitude

The Latitudes available will be +/- 60 degrees

The Longitudes available will be +/- 180 degrees

Spatial Resolutions available will be 2x2.5 degrees, 1/4x1/4 degree, 5 kilometer, and 1 kilometer

3.3.4 *Model Forcing*

Model forcing data will be divided into Base and Observed data.

Base forcing will consist of GEOS or GDAS data.

Observed forcing will consist of AGRMET, NRL, PERSIANN, HUFFMAN, or CMAP data.

Precipitation data (Rainf, Snowf) will be chosen from NRL, PERSIANN, HUFFMAN, or CMAP.

Radiation data (SWdown, LWdown) will be chosen from AGRMET.

Wind Speed data (Wind_N, Wind_E) will be chosen from GEOS or GDAS.

Humidity data (Qair) will be chosen from GEOS or GDAS.

Air Temperature data (Tair) will be chosen from GEOS or GDAS.

Surface Pressure data (Psurf), will be chosen from GEOS or GDAS.

CO2 concentration (CO2air) is not available.

3.3.5 Model Parameters

Vegetation data will be chosen from MODIS and AVHRR

Soil data will be chosen from Original Vegetation-based, Reynolds 0-3.5m data, NLDAS Reynolds 0-2m, or NLDAS Yun 0-2m.

Topography data will be chosen from NASA-EOS, USGS, or none.

The output from the LIS models will nominally be in GRIB. Other options that can be selected for output data will be HDF, Binary and NetCDF (LRD, Sec. 8.4.1 – 8.4.2).

There also will be a selection for the output frequency of every 1hour, 2 hours, 3 hours, or 6 hours.

The LIS configuration web interface will have a selection for restarted runs. If the run is intended to be a restart, it will automatically send the user to another restart screen. The restart screen will ask for the address of the restart input data and ask for the parameters of the new run (LRD, Sec. 6.4 – 6.5). The LIS configuration interface will also have a selection for a LIS Land Surface Model Run online tutorial (LRD, Sec 10). A prototype of the LIS configuration web interface is shown in Figure 4.

LIS Model Runs									
Name of Model Run:				Restart		No ▾		>Online Tutorial	
Model Physics									
Land Surface Model:		CLM ▾							
Temporal Domain				Spatial Domain			Spatial Resolution		
	Year	Month	Day	Hour	Global ▾ - or - User Defined:		2x2/5 deg ▾		
Start:	2002 ▾	Jan ▾	1 ▾	00 ▾	min	max	Sub- grid tiling:		
Stop:	2002 ▾	Jan ▾	1 ▾	00 ▾	Lat:	-59 ▾ 89 ▾			
Timestep:	1800 ▾				Lon:	0 ▾ 360 ▾			
Model Parameters				Model Forcing			Output		
Vegetation:		MODIS ▾		Base: - or -		GEOS ▾		Format:	GRIB ▾
Soils:		Orig veg-based ▾		Observed Precipitation:				Interval (hrs.):	1 ▾
				Observed Radiation:				Location:	Directory ▾
Submit		Reset							

Figure 4: Sample design of LIS User Interface (Level 3)

4 References

ALMA Data Exchange Convention – <http://www.lmd.jussieu.fr/~polcher/ALMA/>

Earth System Grid Quarterly Report, July 10, 2002 -
http://www.earthsystemgrid.org/public/docs/ESGReportJuly02_final.doc

GrADS Home Page - <http://grads.iges.org/grads/grads.html>

Land Data Assimilation System (LDAS) - <http://ldas.gsfc.nasa.gov/>

LDAS GDS Image Generator - <http://ldas.gsfc.nasa.gov/GLDASmap/testgds.html/>

LDAS Real-Time Image Generator - <http://ldas.gsfc.nasa.gov/map/riglive.html>

Live Access Server - http://ferret.wrc.noaa.gov/Ferret/LAS/ferret_LAS.html

LIS Requirements Document - <http://lis.gsfc.nasa.gov/docs/Public/requirements.pdf>

LIS Software Design Document -
http://lis.gsfc.nasa.gov/docs/Public/LIS_swdd_8_13_2002.pdf

NCAR's Data Portal Efforts and The Earth System Grid presentation -
<http://www.dwd.de/UNIDART/Workshop/PowerPoint/MiddletonNCAR.ppt>

NOMADS (NOAA Operational Model Archive and Distribution System) -
<http://data1.gfdl.noaa.gov>

Thematic Realtime Environmental Data Distribution Services home page -
<http://www.unidata.ucar.edu/projects/THREDDS/>